

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor: Yingian Chen et al. Ser. No.: 09/933,508
Filing Date: August 20, 2001 Examiner: R. S. Tupper
Atty. Docket No.: RR-1710 GAU: 2652

For: TRANSDUCERS FOR PERPENDICULAR RECORDING WITH
TRAPEZOIDAL POLE TIPS

February 23, 2004

Mail Stop Appeal Brief
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BRIEF FOR APPELLANTS

This is an Appeal of the Final Rejection of claims 1, 2, 4-10 and 12-24 dated October 8, 2003, as modified by an Advisory Action dated February 13, 2004, which rejected claims 1, 4-9, 12-18 and 20-24. A Notice of Appeal was filed January 7, 2004.

Real Party In Interest

Western Digital (Fremont), Inc. is the assignee of U.S. Application Serial No. 09/933,508 and is the real party in interest.

Related Appeals and Interferences

Appellants know of no other appeals or interferences that will directly affect or be directly affected by or have a bearing on the Board's decision in this pending Appeal.

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Status of Claims

The application was originally filed with 24 claims. Claims 3 and 11 were canceled in an Amendment filed August 19, 2003. Claims 1, 2, 4-10 and 12-24 were

Finally Rejected on October 8, 2003. An Amendment After Final Rejection was filed February 2, 2004, which canceled claims 2, 10 and 19 and amended claims 1, 9 and 17, was entered for purposes of Appeal, according to the Advisory Action dated February 13, 2004. Pending claims 1, 4-9, 12-18 and 20-24 are the subject of this Appeal. Appendix A lists the claims that are the subject of this Appeal.

Status of Amendments

An Amendment After Final Rejection was filed February 2, 2004, which canceled claims 2, 10 and 19 and amended claims 1, 9 and 17, was entered for purposes of Appeal, according to the Advisory Action dated February 13, 2004.

Summary of Invention

The claims on Appeal are directed to devices such as a magnetic head or transducer (100, FIG. 5; ¶26, p. 5) for recording information on relatively-moving media such as disks (102, FIG. 5; ¶26, p. 5), for example in a disk drive system (20, FIG. 1; ¶2, p. 1). Such a device comprises a first soft magnetic layer (113, FIG. 5; ¶26, p. 5) disposed in the head and terminating at a first pole tip (115, FIG. 5; ¶26, p. 5) disposed adjacent to a media-facing surface (128, FIG. 5; ¶28, p. 6), a second soft magnetic layer (105, FIG. 5; ¶26, p. 5) disposed in the body and terminating at a second pole tip (108, FIG. 5; ¶26, p. 5) disposed adjacent to the media-facing surface, the second pole tip having a leading edge (110, FIG. 4; ¶26, p. 5) and a trailing edge (111, FIG. 4; ¶26, p. 5) that bound a shape of the second pole tip, the trailing edge disposed closer than the leading edge to a trailing end of the device, wherein the first and second soft magnetic layers are magnetically coupled (117, 118, FIG. 5; ¶27, p. 6) in a part of the head distal to the media-facing surface. The second pole tip is separated from the first pole tip by at least a micron, the first pole tip has an area substantially larger than that of the second pole tip, the trailing edge is substantially larger than the leading edge, and the second soft magnetic layer has a substantially trapezoidal cross-sectional shape at a location at least one micron from the second pole tip that is substantially equal to the shape of said second pole tip (see e.g., FIG. 12, FIG. 15, FIG. 18).

Issues

(1) Whether claims 1, 4-9, 12, 14-18 and 20, and 22-24 are unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 6,504,675 to Shukh et al.?

(2) Whether claims 13 and 21 are unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 6,504,675 to Shukh et al. in view of U.S. Patent Number 6,513,228 to Khizroev et al.?

Grouping of Claims

Claims 1, 4-9, 12, 14-18 and 20, and 22-24 relate to Issue No. 1. The claims of this group do not stand or fall together.

Claims 13 and 21 relate to Issue No. 2. The claims of this group do not stand or fall together.

Argument

I. Claims 1, 4-9, 12, 14-18 and 20, and 22-24 are not unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 6,504,675 to Shukh et al.

The Final Rejection states:

Note figures 1, 2, and 6. SHUKH et al shows a perpendicular magnetic recording head having a soft first magnetic return layer/pole (21) and a second magnetic write layer/pole 22 which is magnetically coupled to the return pole remote from the media (see figure 2). The second write pole has a trapezoidal shape. The head is used in a disk drive system with an actuator that moves the head between plural tracks (see figure 1). The perpendicular recording medium is shown in figure 2.

SHUKH et al differs in not listing any dimensions for the head (re claims 1, 3, 9, 11, and 17).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to configure the head of SHUKH et al to have the listed dimensions. The motivation is as follows: these would have been the result of routine experimentation and optimization. One of ordinary skill in the art would routinely experiment and optimize where no dimensions were disclosed.

Appellants respectfully disagree with the Final Rejection assertion that it “would have been obvious to one of ordinary skill in the art at the time the invention was made to

configure the head of SHUKH et al to have the listed dimensions.” There is no depiction or description in Shukh et al. of the shape of the second soft magnetic layer away from the ABS. In contrast, Shukh et al. state, for example in the Summary of the Invention: ‘This is accomplished by controlling the shape of the trailing write pole *at the air bearing surface (ABS)*’ (column 1, lines 65-67), and ‘the pole of the writer has a trapezoidal cross-section *at the ABS* with a wide and flat trailing edge and tapered sides’ (column 2, lines 3-4). Similarly, Shukh et al. state: ‘In accordance with the present invention...the shape of the write pole section 12 *at the ABS* is controlled’ (column 3, lines 38-40) and ‘FIG. 6 is a view *from the ABS* of a write head according to the present invention with a trapezoidal shape of the top pole’ (column 2, lines 36-38). Thus Shukh et al. either did not recognize that merely shaping a write pole tip at the ABS may not be ideal, or Shukh et al. were not able to shape the write pole layer away from the ABS, in either case demonstrating nonobviousness of the claims at issue.

Appellants also respectfully disagree with the Final Rejection assertion that “the listed dimensions... would have been the result of routine experimentation and optimization.”

To imbue one of ordinary skill in the art with knowledge of the invention in suit, when no prior art reference or references of record convey or suggest that knowledge, is to fall victim to the insidious effect of a hindsight syndrome wherein that which only the inventor taught is used against its teacher.

W.L. Gore & Assocs., Inc. v. Garlock, Inc., 220 USPQ 303, 312–13 (Fed. Cir. 1983), cert. denied, 469 U.S. 851 (1984).

At best the Final Rejection appears to be invoking an “obvious to try” standard for obviousness.

In *Deuel*, . . . the court emphasizes that “obvious to try” is not the standard under 35 USC 103. As stated in *In re Eli Lilly and Co.*, . . .

An “obvious-to-try” situation exists when a general disclosure may pique the scientist’s curiosity, such that further investigation might be done as a result of the disclosure, but the disclosure itself does not contain a sufficient teaching of how to obtain the desired result, or that the claimed result would be obtained if certain directions were pursued.

Ex parte Goldgaber, 41 USPQ 2d 1172, 1177 (B.P.A.I. 1996) (quoting *In re Eli Lilly and Co.*, 14 USPQ 2d 1741, 1743 (Fed. Cir. 1990)).

Claim 1 includes the limitation that “said second soft magnetic layer has a substantially trapezoidal cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip.” Appellants respectfully assert that this limitation is not taught or suggested in Shukh et al. Aside from a “conventional head for perpendicular recording on a bilayer media” shown in FIG. 2, Shukh et al. do not indicate what shape a write pole of that invention has except for ‘*at the air bearing surface (ABS).*’ In other words, Shukh et al. do not teach that “said second soft magnetic layer has a substantially trapezoidal cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip.”

As noted in the specification of the present application, it is possible to shape a write pole tip at the ABS by focused ion beam (FIB) etching of the media-facing surface, without reshaping the write pole layer away from the ABS (see paragraph 34). Shaping a pole layer to be trapezoidal during earlier processing is more difficult, as described in Appellants’ specification in paragraphs 35-46 (corresponding to FIG. 9 – FIG. 18), but has the advantage that the pole layer cross-sectional shape is substantially equal to the shape of the trapezoidal second pole tip. As noted in Appellants’ specification in paragraph 34, shaping a write pole tip at the ABS as disclosed by Shukh et al. can result in fringe fields that defocus the magnetic pattern on the media, and does not lend itself to wafer level processing.

In response to Appellants’ reasoning, the Final Rejection states:

Appellant argues that SHUKH et al does not disclose that the second magnetic layer have the trapezoidal shape remote from the pole tip.

This is in error. There is absolutely no basis for saying that the second magnetic layer has the trapezoidal shape only at the extreme end. A complete reading of the SHUKH et al disclosure clearly indicates that the trapezoidal shape at least extends away from the end of the pole tip, if not for the entire extent of that layer.

The Final Rejection does not point to a single line or figure in Shukh et al. to support its contention. Instead, the Final Rejection appears to be declaring that a material limitation of the claims on Appeal must be present in Shukh et al. because Shukh et al. do not indicate that the limitation does not exist.

In short, the Final Rejection fails to provide prima facie case of obviousness of the claims on Appeal over Shukh et al.

After receiving the Final Rejection, Appellants obtained a copy of Provisional Application Serial No. 60/175,860 and Provisional Application Serial No. 60/206,872, which were referenced in Shukh et al., to determine whether those Provisional Applications disclosed a write pole having “a substantially trapezoidal cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip.”

Application Serial No. 60/206,872, like Shukh et al., provides no indication of how to make “a substantially trapezoidal cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip.” In contrast, the Summary of the Invention in Application Serial No. 60/206,872 states: ‘This is accomplished by using a special shape of the trailing pole *at the ABS*,’ clearly implying that the shape of the pole is different away from the ABS. Similarly, claim 1 of Application Serial No. 60/206,872 recites a ‘trapezoidal shape of the cross-section *at the ABS*,’ also implying that the shape of the pole is not trapezoidal away from the ABS. Moreover, the Abstract of Application Serial No. 60/206,872 describes ‘a trapezoidal cross-section of the top pole *at the ABS*,’ further implying that the cross-section of the pole is not trapezoidal away from the ABS.

Application Serial No. 60/175,860 also does not disclose how to make “a substantially trapezoidal cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip.” Application Serial No. 60/175,860 instead states, on page 2, “Geometry as proposed in figure 2 can be easily obtained by over-plating. In this case, the thickness of photo-resist is chosen to be less than the total thickness of the pole. Over-plating results in a mushroom effect giving the desired shape.” Appellants respectfully assert that a mushroom shape would have a rounded trailing edge that is materially different than the substantially trapezoidal shape recited in the claims on Appeal.

Application Serial No. 60/175,860 also states, on page 2, “Alternatively, a use of negative photo-resist can be used to give the desired slope.” Appellants respectfully assert, however, that processing of a negative photo-resist results in removing regions

that were not developed by exposure to light. Appellants further assert that light intensity may attenuate in a photo-resist as the light travels from the side of the resist that is exposed to the light toward the side that is removed from the light. In other words, regions of a photo-resist layer that are closer to the surface that receives the light absorb some of the light during development, and thus less light is available to develop deeper regions of the photo-resist layer. Thus, photo-resist regions that are exposed by a mask opening and developed by light may become narrower than the opening in regions further from the exposed surface, as the light intensity attenuates through the resist. After developer has removed undeveloped regions of such a negative photo-resist, the region that is open for electroplating a pole layer may be broader at the bottom and narrower at the top, which would result in a trailing edge that is smaller than a leading edge of such a pole layer, in contrast to the claims on Appeal.

Moreover, *assuming arguendo* that a negative resist could be used to form a pole layer with a trailing edge that was larger than a leading edge, Appellants respectfully assert that such a pole layer would not be substantially trapezoidal as recited in the claims on Appeal. Initially note that, for a photo-resist channel that has walls angled to be wider at the top, a uniform rate of growth of electroplated material in the channel would cause the top surface of a pole layer created by this electroplating to be rounded rather than flat. This is because the plated material along the angled walls grows in sideways as well as upward directions, whereas the material near the middle of the channel grows only upward, so that the material near the middle grows relatively further in the upward direction. Added to this effect is the fact that electroplating does not occur at a uniform rate within such a channel, but rather the plated material grows faster near the middle of the channel than at the walls. Appellants believe that this is due to greater mobility of the electroplating solution near the middle of the channel compared to the walls, as implied by solving Navier-Stokes equations of fluid dynamics for the boundary conditions imposed by the channel. The trailing edge produced by electroplating is therefore rounded as opposed to flat, so that such a pole layer would not be substantially trapezoidal as recited in the claims on Appeal.

Moreover, as stated in Rockwell Int'l Corp. v. United States, 47 USPQ 2d 1027, 1032 (Fed. Cir. 1998):

That prior art patents may have described failed attempts or attempts that used different elements is not enough. The prior art must be enabling. See *Motorola, Inc. v. Interdigital Tech. Corp.*, 121 F.3d 1461, 1471, 43 USPQ 2d 1481, 1489 (Fed. Cir. 1997) ("In order to render a claimed apparatus or method obvious, the prior art must enable one skilled in the art to make and use the apparatus or method." (quoting *Beckman Instruments, Inc. v. LKB Produkter AB*, 892 F.2d 1547, 1551, 13 USPQ 2d 1301, 1304 (Fed. Cir. 1989))).

Appellants respectfully submit that it is not trivial to make a second pole layer having "a substantially trapezoidal cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip." The present specification includes ten figures and six pages of text that teach how to make such a device. Neither Shukh et al. nor the Provisional Applications referenced therein teach or suggest how to make the device defined in the claims on Appeal. Shukh et al. and Provisional Application Serial No. 60/206,872 never describe or depict a trapezoidal cross-section that is removed from the ABS, and clearly imply that the trapezoidal shape is limited to the ABS. Provisional Application Serial No. 60/175,860 also fails to disclose "a substantially trapezoidal cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip." Moreover, although Provisional Application Serial No. 60/175,860 teaches how to make a "mushroom" shaped pole layer, that application does not teach one of ordinary skill in the art to make a "trapezoidal" shaped pole layer as recited in the claims on Appeal.

The failure of the Provisional Applications to teach how to make a second pole layer having "a substantially trapezoidal cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip," strengthens the argument that claim 1 is nonobvious.

Claim 5 recites "The device of claim 1, further comprising a magnetoresistive sensor disposed adjacent to one of said pole tips." Shukh et al. do not teach or suggest such a sensor, and so claim 5 is separately patentable compared to claim 1.

Claim 6 recites "The device of claim 1, wherein said second soft magnetic layer is magnetically coupled to said first soft magnetic layer with a third magnetically permeable layer." Shukh et al. do not disclose such a third magnetically permeable layer that

magnetically couples the second soft magnetic layer to the first soft magnetic layer, and so claim 6 is separately patentable compared to claim 1.

Claim 7 recites “The device of claim 1, wherein the media has an easy axis of magnetization substantially perpendicular to said media-facing surface.” Shukh et al. do not disclose that the media has an easy axis of magnetization substantially perpendicular to the media-facing surface, and so claim 7 is separately patentable compared to claim 1.

Appellants have amended claim 9 to include the limitation that “said second soft magnetic layer has a cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip.” As discussed above regarding claim 1, this limitation is not taught or suggested in Shukh et el.

Claims 11, 12 and 14-16 are nonobvious over Shukh et el. for at least the reasons given above with regard to claim 9.

Claim 14 recites “The device of claim 9, wherein said second soft magnetic layer is magnetically coupled to said first magnetically permeable layer with a third magnetically permeable layer.” Shukh et al. do not disclose such a third magnetically permeable layer that magnetically couples the second soft magnetic layer to the first magnetically permeable layer, and so claim 14 is separately patentable compared to claim 9.

Claim 15 recites “The device of claim 9, wherein the disk contains a media layer having an easy axis of magnetization substantially perpendicular to said media-facing surface.” Shukh et al. do not disclose such a media layer having an easy axis of magnetization substantially perpendicular to said media-facing surface, and so claim 15 is separately patentable compared to claim 9.

Claim 17 has been amended to include the limitation that “said second soft magnetic layer has a cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip.” As discussed above regarding claim 1, this limitation is not taught or suggested in Shukh et el.

Claims 18, 19 and 21-24 are nonobvious over Shukh et el. for at least the reasons given above with regard to claim 17.

Claim 22 recites “The system of claim 17, wherein said media layer has an easy axis of magnetization substantially perpendicular to said media-facing surface.” Shukh et al. do not disclose such a media layer having an easy axis of magnetization substantially perpendicular to said media-facing surface, and so claim 22 is separately patentable compared to claim 17.

II. Claims 13 and 21 are not unpatentable under 35 U.S.C. §103(a) as being obvious over U.S. Patent Number 6,504,675 to Shukh et al. in view of U.S. Patent Number 6,513,228 to Khizroev et al.

The Final Rejection states:

SHUKH et al shows a perpendicular magnetic recording head substantially as claimed.

SHUKH et al differs in not showing the read head.

It is well known to combine read and write heads in one structure. KHIZROEV et al. shows a combined perpendicular write and MR read head.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to provide an attached MR read head on the write head of SHUKH et al as shown by KHIZROEV et al. The motivation is as follows: this is a well known and common combination. One of ordinary skill in the art would utilize such a known configuration where none was specified.

Appellants respectfully disagree with the Final Rejection assertion that “SHUKH et al shows a perpendicular magnetic recording head substantially as claimed.” As discussed above, the Final Rejection fails to provide a prima facie case of obviousness of the independent claims on Appeal over Shukh et al.

Khizroev et al. also do not teach or suggest the limitation that “said second soft magnetic layer has a substantially trapezoidal cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip.” For at least this reason, pending claims 13 and 21 are nonobvious over Shukh et al. in view of Khizroev et al.

Conclusion

Appellants respectfully assert that all the pending claims are allowable and therefore request reversal of the Examiner's rejections. The Final Rejection has not stated a prima facie case of obviousness for any of the pending claims. Instead, the Final Rejection has said essentially that it would have been 'obvious to try' to modify the prior art to achieve the limitations defined by the claims, or that the prior art must disclose the limitations because the prior art does not state that it does not disclose the limitations. This is not the standard for obviousness.


This Appeal Brief is being submitted in triplicate along with a check in the amount of \$330.00 to pay the requisite fee.

Respectfully submitted,


CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Mail Stop Appeal Brief, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313, on February 23, 2004.

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Appendix A

1. A device for recording information on a relatively-moving media, the device comprising:

a body having a leading end, a trailing end, and a media-facing surface,

a first soft magnetic layer disposed in said body and terminating at a first pole tip disposed adjacent to said media-facing surface,

a second soft magnetic layer disposed in said body and terminating at a second pole tip disposed adjacent to said media-facing surface, said second pole tip having a leading edge and a trailing edge that bound a shape of said second pole tip, said trailing edge disposed closer than said leading edge to said trailing end,

wherein said first and second soft magnetic layers are magnetically coupled in a part of said body distal to said media-facing surface,

said second pole tip is separated from said first pole tip by at least a micron,

said first pole tip has an area substantially larger than that of said second pole tip,

said trailing edge is substantially larger than said leading edge, and

said second soft magnetic layer has a substantially trapezoidal cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip.

4. The device of claim 1, further comprising an arm coupled to said body and pivoting to position said body over different parts of the media.

5. The device of claim 1, further comprising a magnetoresistive sensor disposed adjacent to one of said pole tips.
6. The device of claim 1, wherein said second soft magnetic layer is magnetically coupled to said first soft magnetic layer with a third magnetically permeable layer.
7. The device of claim 1, wherein the media has an easy axis of magnetization substantially perpendicular to said media-facing surface.
8. The device of claim 1, wherein the media has a soft magnetic underlayer.
9. A device for recording information on a spinning disk, the device comprising:
 - a slider having a leading end, a trailing end, and a disk-facing surface,
 - a first soft magnetic layer disposed in said slider and terminating at a first pole tip disposed adjacent to said disk-facing surface,
 - a second soft magnetic layer disposed in said slider and terminating at a second pole tip disposed adjacent to said disk-facing surface, said second pole tip having a leading edge and a trailing edge that bound a shape of said second pole tip, said trailing edge disposed closer than said leading edge to said trailing end,
 - wherein said first and second soft magnetic layers are magnetically coupled in a part of said slider distal to said disk-facing surface,
 - said second pole tip is separated from said first pole tip by at least a micron,

said first pole tip has an area substantially larger than that of said second pole tip,

said trailing edge is substantially larger than said leading edge, and

said second soft magnetic layer has a substantially trapezoidal cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip.

12. The device of claim 9, further comprising an arm connected to said slider and moveable to position said slider at plural distances from a center about which the disk is spinning.

13. The device of claim 9, further comprising a magnetoresistive sensor disposed adjacent to one of said pole tips.

14. The device of claim 9, wherein said second soft magnetic layer is magnetically coupled to said first magnetically permeable layer with a third magnetically permeable layer.

15. The device of claim 9, wherein the disk contains a media layer having an easy axis of magnetization substantially perpendicular to said media-facing surface.

16. The device of claim 9, wherein the disk has a soft magnetic underlayer.

17. An information storage system comprising:

a rigid disk spinning about a disk center, said disk having a media layer adjacent to a disk surface,

an arm having a free end adjacent to said disk surface, said arm adapted to move said end toward and away from said disk center,

a body coupled to said free end, said body having a leading end, a trailing end, and a disk-facing surface, said disk-facing surface disposed adjacent to said disk surface,

a first soft magnetic layer disposed in said body and terminating in a first pole tip disposed adjacent to said disk-facing surface,

a second soft magnetic layer disposed in said body and terminating at a second pole tip disposed adjacent to said disk-facing surface, said second pole tip having a leading edge and a trailing edge that bound a shape of said second pole tip, said trailing edge disposed closer than said leading edge to said trailing end,

wherein said first and second soft magnetic layers are magnetically coupled in a part of said body distal to said media-facing surface,

said second pole tip is separated from said first pole tip by at least a micron,

said first pole tip has an area substantially larger than that of said second pole tip,

said trailing edge is substantially larger than said leading edge,

said second soft magnetic layer has a substantially trapezoidal cross-sectional shape at a location at least one micron from said second pole tip that is substantially equal to said shape of said second pole tip.

18. The system of claim 17, wherein said second pole tip is disposed adjacent to a substantially circular disk track that is concentric with said disk center, and said trailing edge is not perpendicular to said disk track at a point of said track that is nearest to said trailing edge.

19. The system of claim 17, wherein said disk has first and second substantially circular and concentric tracks, and said pole tips are aligned with said first track and not aligned with said second track.

21. The system of claim 17, further comprising a magnetoresistive sensor disposed adjacent to one of said pole tips.

22. The system of claim 17, wherein said media layer has an easy axis of magnetization substantially perpendicular to said media-facing surface.

23. The system of claim 17, wherein said disk has a soft magnetic underlayer disposed adjacent to said media layer.

24. The system of claim 17, wherein said media layer has pattern of magnetization with a trapezoidal shape.